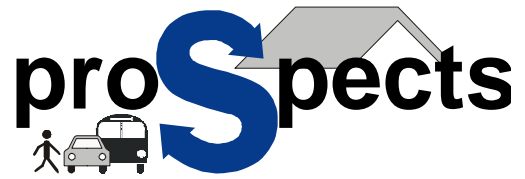




KUNGL
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Task 12 Report: Trends and Scenarios

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OF THE 5TH FRAMEWORK PROGRAMME**

Preface

PROSPECTS (Procedures for Recommending Sustainable Planning of European City Transport Systems) is a project funded under the European Commission's Environment and Sustainable Development Programme. It is designed to provide cities with the guidance they need in order to generate optimal land use and transport strategies to meet the challenge of sustainability in their particular circumstances. The PROSPECTS consortium is led by ITS, University of Leeds and includes the partners TUW (Vienna), TØI (Oslo), KTH (Stockholm), UPM (Madrid) and VTT (Helsinki).

This note contains the report on task 12 of PROSPECTS, for which KTH has had responsibility. It is not a part of the formal deliverables of the project. The report was written by Farideh Ramjerdi and Daniel Jonsson. All PROSPECTS partners have contributed to the work on the task.

We would like to thank representatives of planning authorities, politicians and organisations in the six cities of Edinburgh, Vienna, Oslo, Stockholm, Madrid and Helsinki MA for their contribution during a series of interviews. The views expressed by the interviewed representatives have however been personal and do not necessarily reflect the standpoints of the cities.

Stockholm, February 2001
Royal Institute of Technology

Farideh Ramjerdi
Associate Professor

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1 Introduction and background

1.1 Introduction

The principal objective of the PROSPECTS projects is to provide cities with the guidance which they need in order to generate optimal land use and transport strategies to meet the challenge of sustainability. The first sub objective handled, under the heading Work Package 10 (WP10), is to identify cities' decision-making needs.

This report presents the results of task 12, one of the tasks that make up WP10. It is a review of past trends and the way they are reflected in our six Core Cities, and the way they are used in the analysis of the futures for which the cities plan. In the report the results related to trends and scenarios from the wider city survey (Task 16) are also presented, together with the results from the Core Cities.

1.2 Aim

The aims of this task are to review past trends in policy performance, and future generic and local scenarios that provide the context within which the policies will need to develop. The efforts lead to the alternative scenarios to be used in later work packages. We aim to produce both specific scenarios for each city and generic ones for the EU, which reflect trends in EU policy, economic developments, urbanisation, demographic changes, competition and regulation and technological changes. The objective has been to answer the following questions:

- What have been the most important trends in exogenous variables in the context of the urban (land use) and transportation systems' performances?
- What are the most important exogenous variables to be included in a future scenario?
- How are uncertainties related to future trends of exogenous variables dealt with?
- What time scale(s) should scenarios cover?
- How to formulate a set of necessary (minimum number of) scenarios for future in order to address these uncertainties?
- What are the objectives of scenario analysis?

1.3 Method

Based on review of literature an initial questionnaire was designed and presented to our six core cities (see Appendix A). It was revised following the first interviews to treat the most important past trends and future developments in exogenous variables. The interviewees were also encouraged to give their views on the level of uncertainty connected to each of these. The second questionnaire can be found in Appendix B. The combined results from the two interviews are presented in sections 2 and 3.

1.4 Background

Planning can be defined as a formalised procedure to produce an articulated result in the form of an integrated system of decisions (Höjer, M., 2000). It is in this context that one needs to define a scenario. Scenarios can be defined as projective and prospective (see Becker et al., 1982, Van der Heijden, 1996, Makridakis et al., 1998). In another word scenario is defined as either the future development or a future state. A projective scenario's starting point is the current situation: extrapolation of current trends results in future images. A prospective scenario's starting point is a

possible or desirable future situation, usually described by a set of goals or targets; established by assumed events between the current and future situation. The context for a scenario refers to general “macro developments”, e.g. assumptions about economic development, demography, the stability of the supply of fossil fuels, prices of fossil fuels, international relationships, assumed behavioural changes, etc (Geurs and Ramjerdi, 1997).

Lee (1994) separates planning into three types, although he points out that there are no clear boundaries between these types. Figure 1 shows the trade-off between the time horizon of the planning decision and the level of detail (Lee, 1994).

Strategic planning: The horizon in strategic planning is long term. The goal is to explore future options. The objective is to allow for the future options in spite of the limitations of the present actions, unless this limitation is recognised and accepted. Trade-offs among goals can be evaluated, however, specific outcomes or end-state objectives should be avoided.

Tactical planning: Alternatives are formulated and evaluated, ideally as benefit-cost questions, and preferences among alternatives are established at the tactical level.

Implementation planning: The execution of tactical decisions also requires considerable planning and evaluation of alternatives.

In PROSPECTS the scenarios has a projective definition. The desirable future achieved by weighting the objectives optimally and is specified through policy instruments. The scope of PROSPECTS demands a comprehensive planning approach (see Figure 1).

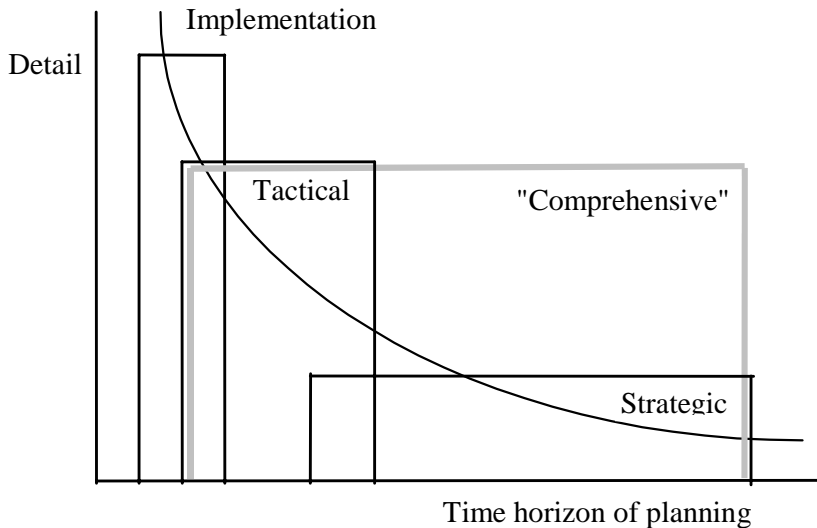


Figure 1 Trade-offs among strategic, tactical and implementation planning (Lee, 1994)

Objectives of a study should determine the distinctions between exogenous and endogenous variables. Endogenous variables are in fact the different indicators by means of which we can evaluate the achievements of the objectives. However, different planning tools have different possibilities or capabilities in explicitly addressing the complex interactions between different exogenous variables, policy variables and endogenous variables. Planning tools, such as a LUTI model should be scientific and should advance theory. Further more these tools should meet certain

standards such as transparency. The different requirements set demands as well as limitations on exogenous variables, policy variables and endogenous variables that can be addressed by such tools. Since LUTI models are usually large-scale models, they require time and effort for the calculation of a scenario together with policy variables, and the assessment of the changes in endogenous variables (indicators) in order to conclude on the achievements of the objectives of the study.

It is important to point out that the exogenous variables in a scenario are not totally independent of each other. An example is the change in employment and economic development or changes in car ownership and economic development. This is why a future scenario, composed of these variables, has to present a coherent picture of that future. Further more, it is not always a very simple task to draw a clear line between an exogenous and an endogenous variable. An example is economic development, which is usually included as an exogenous variable in a scenario, but is also usually an important indicator or objective

Uncertainties associated with the development of the exogenous variables will create uncertainty about the state of the future. It is commonly known and empirical evidence suggests that a simple averaging of predictions improves forecasting accuracy and reduces uncertainty (S. G. Makridakis, 1990). Uncertainties about future states can be addressed by a scenario study. The level of uncertainties depends on time scale. Generally, the longer the horizon, the higher the level of uncertainty. A scenario study should address a minimum number of scenarios in order to cover the range of uncertainties in future developments and related to the objectives.

2 Trends

2.1 Most important variables

The aim has been the identification of the most important trends in exogenous variables in the context of the urban (land use) and transportation systems performances. The following trends have been identified by different cities as important in influencing the performance of their urban and transportation systems.

Table 1 lists the trend variables, which the Core Cities identified as the most important in influencing current conditions, and the rank orders which they gave.

City/Rank	Vienna	Oslo	Edin- burgh	Madrid	Helsinki	Stock- holm
Population growth	10	2	5	1	1	1
Age structure of population	8					2
Household structure	7					
Economic growth		3	1	2	3	3
Changes in job/employment struc- ture	9	4				4
Changes in total employment		1			2	
Division of labour, specialisation	2					
Restructuring businesses and changes in work arrangement			4			
Car ownership			2	3	5	5
Changes in relative prices	3		6			
Changes in surface coverage of the city	5				4	
Changes in population density	6					
Decentralisation/urban sprawl	1			4		
Changes in work location	4			5		6
Changes in home location				6		
Changes in land use			9			
Changes in tourism and leisure ac- tivities			8			
Retail changes			3			
Changes in city image			7			
Changes in national policies		5				

Table 1. Rankings of the important trends by the Core Cities (Rank 1= most important)

Table 1 shows that the following ten variables have been identified by two or more Core Cities; the numbers identifying them are shown in brackets (also note that not all cities have ranked ten variables):

- 1 Population growth (6)
- 2 Economic growth (5)
- 3 Changes in car ownership (4)
- 4 Changes in job/employment structure (3)
- 5 Changes in employment location (3)
- 6 Age structure of population (2)
- 7 Changes in total employment (2)
- 8 Changes in relative prices (2)
- 9 Changes in surface coverage of the city (2)
- 10 Decentralisation/urban sprawl (2)

It should be noted that these variables are not wholly independent of one another; for example, employment will be correlated with economic and population growth. Even though the ranking of the importance of these variables is city dependent, the Core Cities have identified some common trends.

It is also important to acknowledge some common aspects of the Core Cities; they are all capital cities. The increase in population of the larger regional centres in Europe has been usually accompanied with a decline of the smaller cities, and the larger centres have had a larger share from the recent economic growth than the small cities.

2.2 Other variables

Some trends identified by the project team as of potential importance were not specified by the Core Cities. These were changes in female participation in the workforce; changes in fuel efficiencies; and development of intelligent transport systems.

There were very few suggestions for additional exogenous variables in trends. However, the following additional exogenous variables have been cited as important.

- Changes in disposable income
- Changes in income distribution
- Changes in tax structure
- Division of labour and specialisation (changes in the labour market?)
- Restructuring businesses (subcontracting, outsourcing, consulting, downsizing, customising, etc) and changes in work arrangement (self employed, temporary workers, part-time worker)
- E-commerce (B2B and B2C)
- Changes in tourism and leisure activities
- Changes in city image
- Organisational changes in regional/local government

2.3 Survey cities

Survey cities' views were sought on the importance of the top five from the above list, and their responses are given in Table 2. In general, there appears to be a good level of agreement between our core cities and the survey cities. It shows that 76% of cities feel that employment location has been important (or very important) to them, whilst population growth, economic growth and car ownership have been important to approximately 70% of cities and employment structure has been important to 44%. In addition, survey cities have suggested a number of other variables that have been important in their city, including location of schools, urban and social structures and the development of environmental legislation. Smaller cities place more emphasis on population growth, less on employment location, and much less on employment structure than do medium and larger cities; medium cities place less importance on employment growth and car ownership than do small and large cities.

	Very im- portant	Important	Quite im- portant	Not at all im- portant	Not stated
Population growth	23	14	11	4	2
Economic growth	13	24	11	5	1
car ownership	23	15	12	3	1
Employment structure	10	14	24	5	1
Employment location	15	26	10	1	2

Table 2 Importance of principal trends for survey cities (number of cities)

3 Scenarios

3.1 Most important variables

The aim has been the identification of the most important exogenous variables to be addressed in a future scenario. As in trends, it should be acknowledged that the developments in the exogenous variables are not independent of each other, which demands attention when constructing a scenario. Table 3 shows the summary of the rankings of the most important variables that should be included in a scenario by the Core Cities.

Table 3 shows that the following seven variables have been identified by two or more Core Cities as important contributors to scenarios; the numbers mentioning them are shown in brackets:

- 1 Population growth (4)
- 2 Economic growth (4)
- 3 Changes in work location (3)
- 4 Changes in car ownership (2)
- 5 Changes in surface coverage of city (2)
- 6 Changes in urban sprawl (2)
- 7 Changes in employment (2)

Some variables identified by the project team were not specified by the Core Cities; in particular changes in technology and in fuel efficiency. Others were mentioned, but not considered important; in particular changes in relative prices and in the age structure of the population.

Variable	Vienna	Madrid	Edin- burgh	Oslo	Stock- holm	Hel- sinki
Population growth	10	1		2	2	2
Age structure of the population	8			3	7	
Household structure	7					
Economic growth		2		1	1	3
Changes in job/employment structure	9				6	
Changes in car ownership		3		* ¹		5
Changes in relative prices	3					6
Changes in the surface coverage of city	5					4
Changes in population density	6					
Changes in urban sprawl	1	4				
Changes in work locations	4	5			4	
Changes in home locations		6			5	
Division of labour/specialisation	2					
Organisational changes				4		
Changes in employment					3	1
Attitudes and appreciation						7

Table 3 Rankings of important variables for inclusion in a scenarios (Numbers in the table refer to the rankings of the variables by the Core Cities. Rank 1 = most important)

3.2 Survey cities

From the list above, the survey cities' views were sought on the first five variables, and their responses are given in Table 4. In general, there is again a good level of agreement between our Core Cities and the Survey Cities, with over 80% identifying economic growth and changes in employment location as important or very important, and between 61% and 72% of cities stating car ownership, population growth and size of the urban area as important or very important. Smaller cities placed less emphasis on employment and car ownership than medium and large cities. Medium cities place greater emphasis on population growth, and large cities greater emphasis on economic growth. There were few differences in emphasis on size of the urban area.

¹ For Oslo, changes in car ownership are not among the ranked variables although planners consider this variable very important, but they felt that it is included in the economic growth variable.

	Very important	Important	Quite important	Not at all important	NS
Population growth	22	15	13	2	2
Economic growth	23	23	6	0	2
Employment location	26	18	8	1	1
Car ownership	19	14	16	4	1
Size of urban area	26	13	9	4	2

Table 4 Importance of principal scenario variables to survey cities (number of cities)

4 Uncertainties associated with exogenous variables

The short run and long run levels of uncertainties associated with the variables that are identified as the most important variables for the construction of a scenario by the Core Cities are presented in Table 5. It should be pointed out that the respondents in Stockholm did not agree on the level of uncertainties associated with a variable.

As the results in Table 5 suggest, it is not possible to conclude on the level of uncertainties associated with an exogenous variable, except that the respondents assert a higher level of uncertainty on the development of exogenous variables in the long run than in the short run. Economic development is the variable that has highest associated level uncertainties in short and long run. Other variables with high level of uncertainties are changes in work location and total employment. Again it might be worth noting that these may well be highly correlated.

(E = Edinburgh, H = Helsinki, M = Madrid, O = Oslo, S = Stockholm V = Vienna)

Variable	Short run uncertainty			Long run uncertainty		
	High	Medium	Low	High	Medium	Low
Population growth		O	HMSV		HMOSV	
Economic growth	HS	M	O	HMS	O	S
Work location		MV	O	MOV		
Home location			MO		MO	
Surface coverage of city			HOV		HOV	
Urban sprawl		O	HMS		HMOS	
Total employment		H	O	H	O	

Table 5 Short and long run level of uncertainty associated with the an exogenous variable by Core City

5 Scenario planning

Table 6 indicates that all six of the Core Cities specified scenarios in their future planning, although in practice Oslo and Madrid only used a single scenario. In all cases the scenarios can be made available for the project.

Table 6 Use, number and availability of scenarios among Core Cities

City	Are scenarios specified	No. of scenarios	Accessible
Helsinki	Yes	3	Yes
Oslo	Yes	1	Yes
Edinburgh	Yes	3	Yes
Madrid	Yes	1	Yes
Stockholm	Yes	2	Yes
Vienna	Yes	3	Yes

Core Cities use scenarios to help address the uncertainties in planning land use and transport strategies. However, they appear not to have clear views on the number of scenarios required, or on their use for identifying future problems, generating strategy options, or testing their robustness. This is an area in which further advice could usefully be developed. Appendix C provides some further guidance on potential common scenarios.

It has been recognised by the Core Cities that the formulation of a set of future scenarios should allow for the uncertainties in the most important exogenous variables and that the combination of these should make up a coherent picture (scenario) in such a way as to produce a minimum number of scenarios.

6 References

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Appendix A

09 March 2000

KTH, TLA

A note to PROSPECTS partners on task 12 (Trends and Scenarios)

The aims of this task are to review past trends in policy performance, and future generic and local scenarios that provide the context within which the policies will need to develop. Scenario analysis is a means of handling complex future developments by reducing them to a small number of scenarios. Scenarios are defined as exogenous, yet uncertain developments where strategies related to transport and land use are to be implemented.

In order to understand the past trend in policy performance, several threads must be brought together. These are the following:

1. Past trends of exogenous variables where transport and land use strategies are implemented
2. Past trends in transportation system and land use, in terms of two different sets of factors. One that could be connected to strategies and performance, such as traffic volume, level of congestion, reliability and other levels of services such as accessibility, etc. The later factors are in general those have been formulated as indicators (see description of task 11, A note to PROSPECTS partners on task 11, TOI, March 2000). The other factors are the factors that could be related to strategies or policy instruments in different categories of land use measures, infrastructure provision, management of the infrastructure, information provision and pricing (see ITS working paper 545).
3. Identification of how the present indicators of the performance of land use and transport systems are connected to the past strategies and policy instruments.
4. Understanding and formulation of the planning process (if any)
5. Understanding how the planning process relates to the relation between indicators and policy instruments.

The last challenge is the identification of future scenarios. It is possible to address the future scenarios simultaneously with point 1 under "past trends in exogenous variables". However, it should be complemented with additional questions related to exogenous variables that were not significant in the past such as the telecommuting, e-commerce, flexible working arrangements, etc. In the following we address some of these.

1. Past trends in exogenous variables

1. Population growth (natural growth, immigration)
2. Age structure of the population
3. Family structure
4. Economic growth (regional and compared with national economic growth)
5. Changes in job/employment structure, unemployment, women participation in labour force.
6. Changes in car ownership
7. Changes in fuel efficiencies of all modes in particular personal vehicles
8. Use of ITS (intelligent transport system)

2. Past trends in transportation systems

1. Changes in transport infrastructure (networks and terminals), all modes (investments and major upgrading)
2. Changes in relative prices (all modes)
3. Changes in traffic volumes and mode shares
4. Changes in congestion on transport networks (spread, duration, etc)
5. Changes in the level of service provided by the transportation system to the citizens and businesses (accessibility, reliability, etc)
6. Changes in environment (pollution, noise, etc.,)and safety related to transport system
7. Other relevant strategies and indicators that are relevant for the core city to be interviewed (see ITS working paper 545) and indicators (A note to the PROSPECTS partners on task 12, TOI, March 9 2000)

3. Past trends in trends in land use

1. Changes in the surface coverage of the city, or how has the city expanded
2. Changes in population density
3. Changes in urban sprawl/sub-urbanisation
4. Changes in work location
5. Changes in home locations
6. Changes in location of major attraction centres (major shopping centres, universities, hospitals, sport stadiums, etc.)
7. Major new developments
8. Major changes in law related to land use

9. Changes in social integration

4. Understanding and formulation of the planning process (if any)

1. Public attitude towards environment (pollution, noise, etc.), congestion, traffic safety, social integration
2. Is there any integrated land use transport plan for the region (city)?
3. Is there any transport and or land use plan for the region (city)?
4. A description of the process for formulation of a plan
5. Major changes in the process
6. Who are the actors (different local actors, regional, national, etc.) and what are their roles in this process
7. The process of negotiation between different actors
8. What is the level of public participation in this process
9. What is the process for the political acceptance of a plan
10. How is a plan implemented
11. What are the responsible bodies for the implementation of a plan(s)

Questions related to objectives

12. What is the process for the formulation of the overall objective in a plan?
13. Relation between the overall objectives with national objectives
14. Are the overall objectives reformulated to a hierarchical set of objectives
15. How are the conflicting objectives addressed

(See A note to the PROSPECTS partners on task 12, TOI, March 9, 2000)

Indicators

12. How are these objectives translated into indicators?

(See A note to the PROSPECTS partners on task 12, TOI, March 9, 2000)

Strategies

13. How are transport related strategies formulated?
14. How are land use related strategies formulated?

(See ITS working paper 545)

4. Identification of relations between indicators of the performance of land use and transport systems and past strategies and policy instruments (or lack of these)

It would be quite important to find out how different the interviewees relate the performance of the land use and transport systems to the past strategies and policy instruments and how they think other strategies and policy instruments were necessary.

Some important questions are:

1. Are the strategies evaluated individually without taking account of their interactions?
2. How different packages of strategies are chosen?
3. What kind of planning tools are used for the evaluation of strategies?
4. Does the planning process allow for the measurement of the level of achievement of a plan?
5. How did the past plans (integrated land-use transport plan or transport and/or land use plan) have performed in achieving the objectives?

Scenarios

Scenarios are defined as exogenous, yet uncertain developments where strategies related to transport and land use are to be implemented. Yet it is important to identify the changes in transportation and land use system that are binding and will be implemented during the analysis period.

1. Future trends in exogenous variables

1. Population growth (natural growth, immigration)
2. Age structure of the population
3. Family structure
4. Economic growth (regional and compared with national economic growth)
5. Changes in job/employment structure, unemployment, women participation in labour force.
6. Changes in car ownership

7. Changes in fuel efficiencies of all modes in particular personal vehicles
8. Use of ITS (intelligent transport system)
9. How are uncertainties in future trends of exogenous variables are addressed in the planning process?

Binding future changes in the transportation system

10. Binding decisions related to transport infrastructure/networks, all modes
11. Binding decisions related to relative price changes (all modes)
12. Other binding changes in the transportation system

Binding future changes in land use

13. Binding decisions with respect to work and home locations
14. Binding decisions with respect to location of major attraction (major shopping centres, universities, hospitals, sport stadiums)
15. Others

Technological changes

16. Changes in future fuel efficiencies of all modes
17. Use of new fuel technologies
18. Others

Appendix B

PROSPECTS/Task 12/KTH

April 20, 2000

Revised proposal for

Task 12: Trends and Scenarios in urban land use and transport planning for sustainability

The aims of this task are to review past trends in policy performance, and future generic and local scenarios that provide the context within which the policies will need to develop. Scenario analysis is a means of handling complex future developments by reducing them to a small number of scenarios. Scenarios are defined as exogenous, yet uncertain developments which determines the context in which strategies related to transport and land use are to be implemented.

Through the interview we seek to answer the following questions.

1. What have been the most important trends in exogenous variables in the context of the urban (land use) and transportation systems performances?
2. What are the most important exogenous variables to be included in a future scenario?
3. What time scale(s) should scenarios cover?
4. How are uncertainties related to future trends of exogenous variables are dealt with?
5. How to formulate a set of necessary (minimum number of) scenarios for future in order to address these uncertainties?
6. What are the objectives of scenario analysis?

Part 1. Trends

Are data available on past trends in the following exogenous variables? Please specify for what period data is available for each items.

1. Population growth (natural growth, immigration)
2. Age structure of the population
3. Household structure
4. Economic growth (regional and compared with national economic growth)
5. Changes in job/employment structure,
6. Changes in unemployment,
7. Changes women participation in labour force.
8. Changes in car ownership
9. Changes in fuel efficiencies of all modes in particular personal vehicles
10. Use of ITS (intelligent transport system)
11. Changes in relative prices (all modes)
12. Changes in the surface coverage of the city, or how has the city expanded
13. Changes in population density
14. Changes in urban sprawl/sub-urbanisation
15. Changes in work locations
16. Changes in home locations
17. Others, Please specify

Please list up to 10 past trends in order of their importance in influencing the performance of the urban and transportation systems.

1. _____
2. _____
3. _____
4. _____
5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

Part 2. Scenarios

Are scenario(s) specified in the context of urban land use and transport planning for your city? If so, how many?

Are these scenarios accessible for use in PROSPECTS?

Please identify the time scale(s) a scenario should cover and the rationale for the choice of time scale(s).

What are the main purposes of specifying scenarios?

How should a set of scenarios for future be formulated that would address the uncertainties associated with the predictions of exogenous variables?

Please list up to ten "important" exogenous variables that should be addressed in a scenario for future, as well as the level of uncertainty you associate with their predictions.

Please specify a time period for short run year and long run years

1. _____

Short run: High level of uncertainty Moderate level Low level

Long run: High level of uncertainty Moderate level Low level

2. _____

Short run: High level of uncertainty Moderate level Low level

Long run: High level of uncertainty Moderate level Low level

3. _____

Short run: High level of uncertainty Moderate level Low level

Long run: High level of uncertainty Moderate level Low level

4. _____

Short run: High level of uncertainty Moderate level Low level

Long run: High level of uncertainty Moderate level Low level

5. _____

Short run: High level of uncertainty Moderate level Low level

Long run: High level of uncertainty Moderate level Low level

6. _____

Short run: High level of uncertainty Moderate level Low level

Long run: High level of uncertainty Moderate level Low level

7. _____

Short run: High level of uncertainty Moderate level Low level

Long run: High level of uncertainty Moderate level Low level

PROSPECTS
Task 12 Report

8. _____

Short run: High level of uncertainty Moderate level Low level

Long run: High level of uncertainty Moderate level Low level

9. _____

Short run: High level of uncertainty Moderate level Low level

Long run: High level of uncertainty Moderate level Low level

10. _____

Short run: High level of uncertainty Moderate level Low level

Long run: High level of uncertainty Moderate level Low level

Appendix C

Generic Scenarios for European Cities

Many recent studies have relied on the development of medium-and long term generic scenarios for EU (or Europe) as part of their work (see for example research projects SCENARIOS, SEA, POSSUM, STREAMS, CODE-TEN, ASTRA, the EST project by OECD and European Union Energy Outlook to 2020). There are minor differences in their approach to the construction of these scenarios, often referred to as a Business as Usual or a Base Scenario. These scenarios rely on the projection of the present trends concerning demand and modified by likely changes in technology and legislation. Most of these studies do not address uncertainties in future developments that are related with the exogenous variables that formulate these scenarios. Even though there are different levels of uncertainties associated with the exogenous variables in short- medium- and long term at a European scale, the projection of some of these variables for the cities in Europe have higher levels of uncertainties associated with them. Cities of different sizes and in different regions of Europe will have different share of the future growth in economy, population, employment, etc.

Economic development and changes in disposable household income coupled with the growth in population and other demographic changes are probably the most important exogenous variables that have contributed to the growth in demand for travel, in particular by car. Different scenario studies suggest that these variables will continue to keep their significance in future developments. Other variables that are usually included in a scenario are relative prices of transport modes and technological changes or changes in fuel efficiencies. Changes in car ownership can be addressed as an exogenous variable in a scenario, even though some studies have treated this variable as an endogenous variable. Modeling capability determines the choice.

The survey of Core Cities indicates that in the context of urban areas, location variables such as "Changes in work location", "Changes in surface coverage of city", "Changes in urban sprawl " are other important variables for a scenario (see section 4.3 on scenarios). These are the types of variables that are not addressed in previous studies that have used a base scenario on a European scale. Furthermore, the variations of these trends among cities of different sizes have received little attention (almost all studies that focus on the density of built areas use cross sectional data, rather than time series), even though there seems to be a consensus that these are common trends for urban areas.

In the following we address some of the most important variables that should be included in a generic scenario and the projection of some of these variables on a European level.

Demographic Outlook

Demographic conjectures are quite crucial in long-term forecasts with relatively low level of uncertainty. World Bank and US Department of Commerce are widely source for population forecasts. Another source is "European Macro-economic Projections" (1997) and "Preliminary Primes Version 2 Baseline Assumptions (1998). According to Primes, the population growth in EU will decrease from an annual growth rate of about 0.4 percent over the 1985-1995 period to zero growth between 2010 and 2020. There are regional differences in the forecasts of population in Europe. Larger urban areas seem to grow faster the smaller urban areas, due to external migration. These factors increase the level of uncertainty associated with the forecast of the population on a "city level".

An important concern is the aging of the population in EU. There are some projections available on the profiles of aging in different parts of Europe (see for example different studies by OECD in website: <http://www.oecd.org/subject/ageing/>). Average household size is another important determinant of demand for travel. The average size of household is predicted to decrease from 2.6 in 1995 to 2.3 in 2020 (Primes).

Economic Outlook

Global relations and developments formulate the underlying assumptions of an economic scenario. Economic growth is associated with a higher level of uncertainty that the demographic variables, since the underpinning assumptions for the economic developments are more uncertain and usually involves judgements (optimistic or pessimistic views of the developments). OECD and EBRD are two main sources for growth in real GDP and unemployment in the Europe (see for example ECONOMIC OUTLOOK No.68: <http://www.oecd.org/eco/out/eo.htm>). An example of economic outlook in Europe is by Primes, which forecast the annual percent change in GDP of 2.6 between 1995-2000 to eventually decrease to 1.7 in the period of 2015-2020. The associated level of uncertainty with forecasts of economic growth and unemployment for European cities is even higher than a European level in a similar to demographic outlooks. Another important factor is the structural changes in the economy with consequences for employment structure.

Relative prices and energy efficiencies of travel modes

Assumptions related to changes in oil prices are usually most important for the transport sector because of its high dependency on fossil fuels. Other important factors are the assumptions about technological developments as well as legislation (on European or National levels). These are the underlying factors for bringing in uncertainty in the predictions of these variables and their variation on a European level. "Primes" provides forecasts of energy efficiencies by mode as well as the forecasts of the passenger transportation efficiency improvements in different European countries.